Fermi National Accelerator Laboratory

TM-1233
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# Helium Leak Detector Improved Sensitivity Speed Choke

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December 1983

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The cold trapped mass spectrometer helium leak detectors have sensitivities of approximate $1 \times 10^{-10}$ atm cc/sec/divisions. The sensitivity is the pressure (atm) and the rate of flow (cc/sec) from a constant leak (standard leak) per divisions on an output meter.

$$\text{Sensitivity} = \frac{\text{Standard Leak (atm cc/sec)}}{\text{Output Meter (divisions)}}$$

The internal flow rate of the leak detector is determined by the pumping system and the physical construction of the leak detector's vacuum system. Restricting the internal flow rate while maintaining a leak at a constant flow rate the leak detector will exhibit a higher output reading due to accumulation of helium at the mass spectrometer in the leak detector's vacuum system.

A common method of restricting the flow is by installing a fixed choke in the leak detector's vacuum system near the inlet of the internal pumping system. This requires the operator to completely shut down the leak detector's vacuum system, disassemble and install an orifice to restrict the flow. This method is quite cumbersome and time consuming. The major problem with a fixed choke is a longer time to remove the trace gas when a leak is found. The operator must physically remove the fixed choke to resume normal leak detecting. The advantage of the fixed choke is repeatability of the sensitivity.

Another method of increasing the sensitivity by restricting the flow is by partially opening the pumping system's isolation valve. This will provide the operator with a means of reducing clean-up time by opening the valve without interrupting the vacuum. If the sensitivity must be repeatable an operator can spend considerable time trying to find the exact position the valve was opened to before having to open for a quicker clean-up.

The speed choke provides an operator with a method to have a faster clean-up time and a predictable improved sensitivity. The predictable improved sensitivity is accomplished by drilling a hole in a gate valve's sealing plate and mounting the valve on the inlet of pumping system of the mass spectrometer leak detector. Another reason for using a gate valve is that it does not change the internal vacuum system's plumbing to a major extent. When the valve is closed in the system a sensitivity is calculated for use. Simply by opening and closing the valve the operator has the normal clean-up time and the option of two sensitivities.

The size of hole in the gate valve's sealing plate to accomplish an improved sensitivity of a factor of eight was a hole 5/32". The normal sensitivity of $1.6 \times 10^{-10}$ atm cc/sec/divisions went to $2 \times 10^{-11}$ atm cc/sec/divisions when the valve was closed in the vacuum system.

The equipment required to the upgrade a mass spectrometer leak detector is a gate valve, a mounting fixture and threaded rod or long bolts. The gate valve used for our upgrade was a Vat gate valve, series 11 manual with a pull handle, 2" nominal; cat#08112. We purchased the valve from HPS; 1898 Flatiron Ct.; Boulder, Co. 80301.

The mounting of the gate valve requires only a clamp to position the valve between the diffusion pump and the diffusion pump isolation valve on a Dupont 120SSA or 24/120 model mass spectrometer leak detector. The clamp is a top and bottom mounting plate and threaded rod. The original leak detector need not have any major changes to accomplish this upgrade.

The sketches provided show the mounting fixture and the positioning of the valve in the leak detector. This position will permit the operator to use the leak detector as normal.

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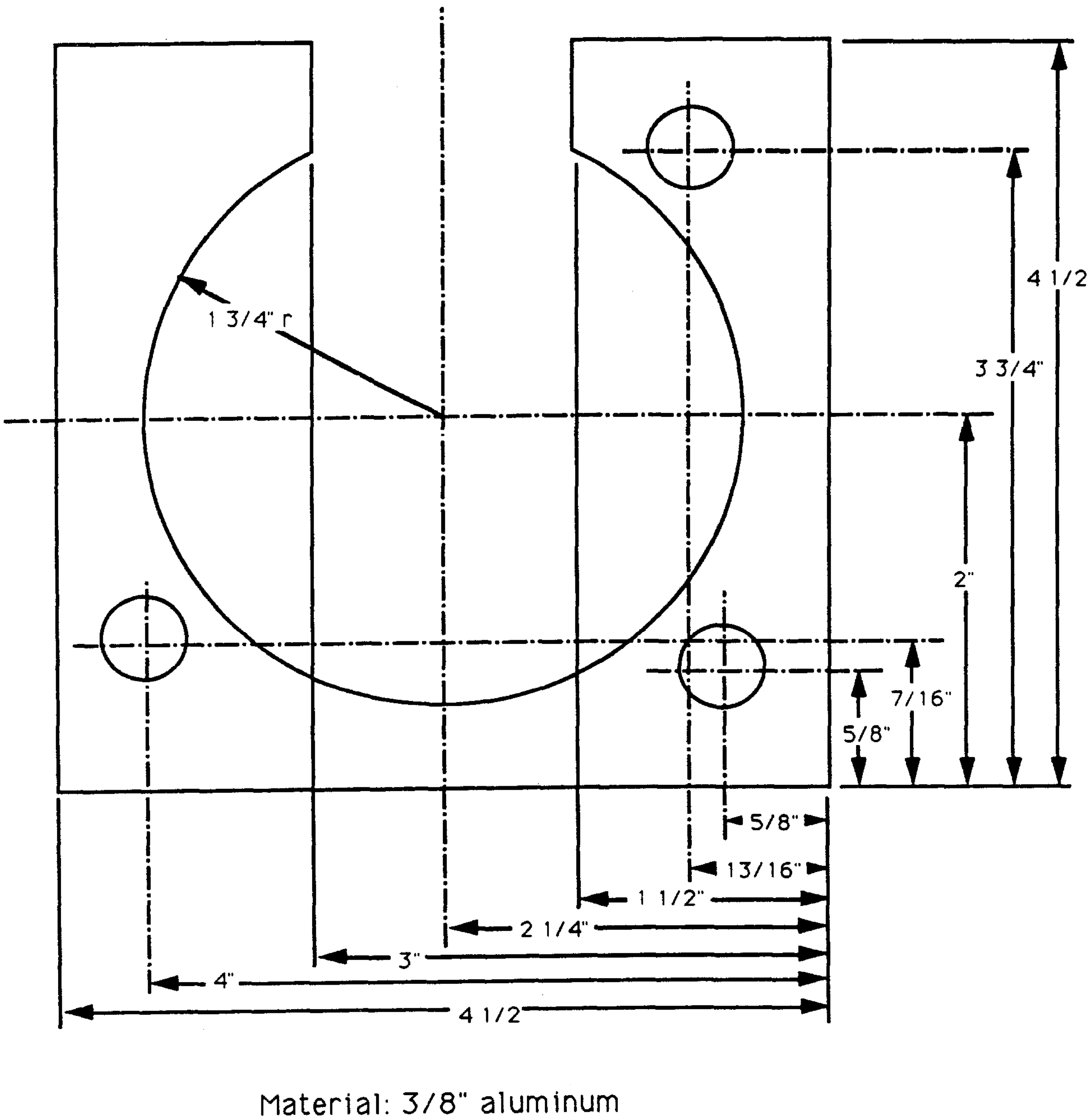
Mounting Flange Bottom




Material: 3/8" aluminum
1/2" thru holes

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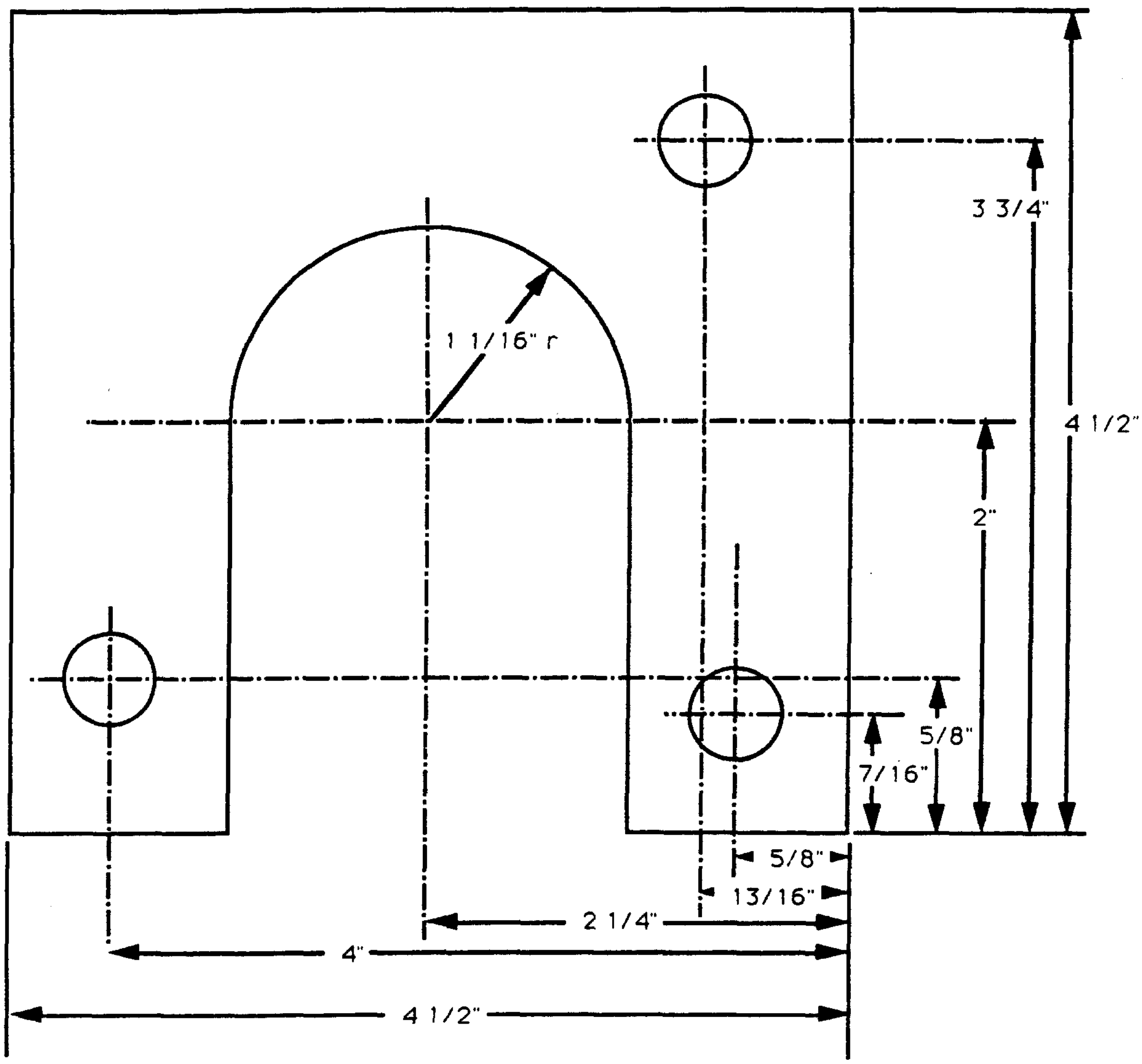
Mounting Plate Top




Material: 3/8" aluminum

3/8 x16 threaded holes

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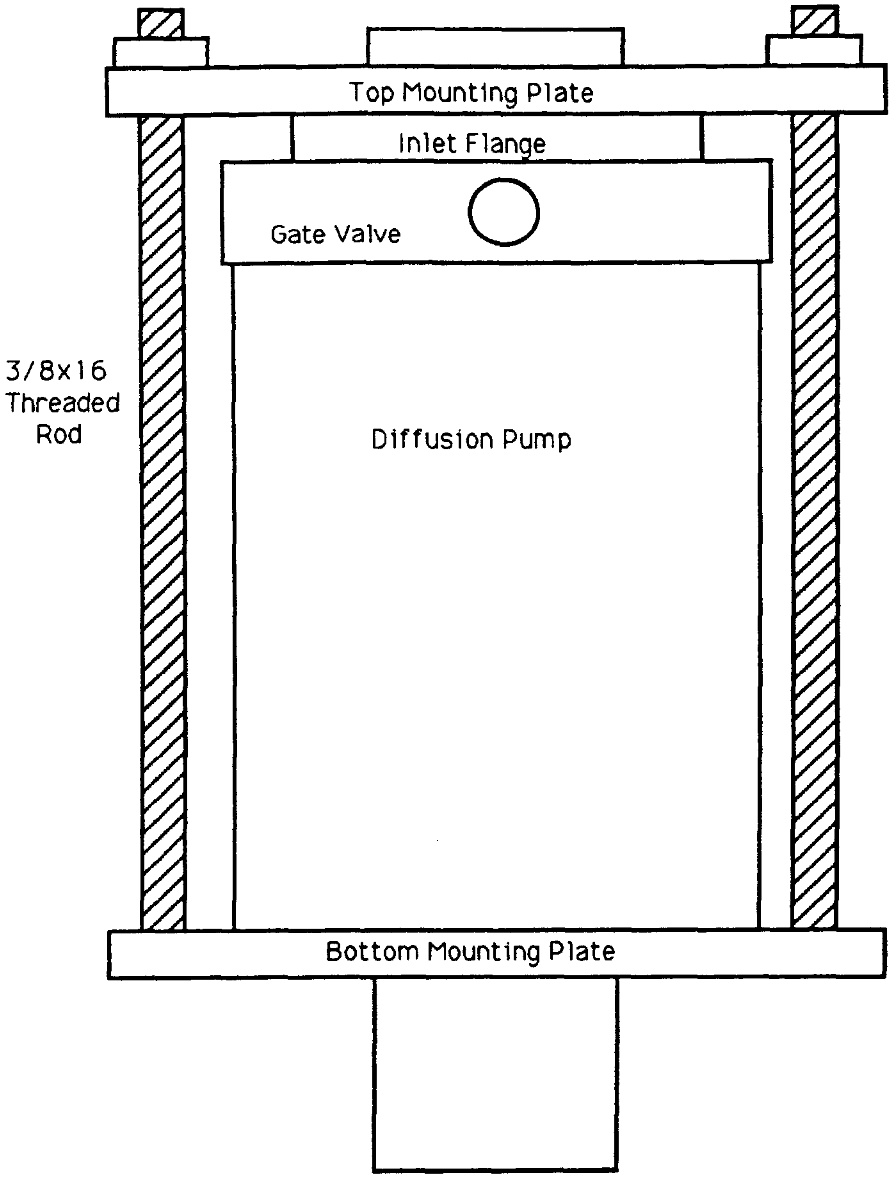
Valve Location



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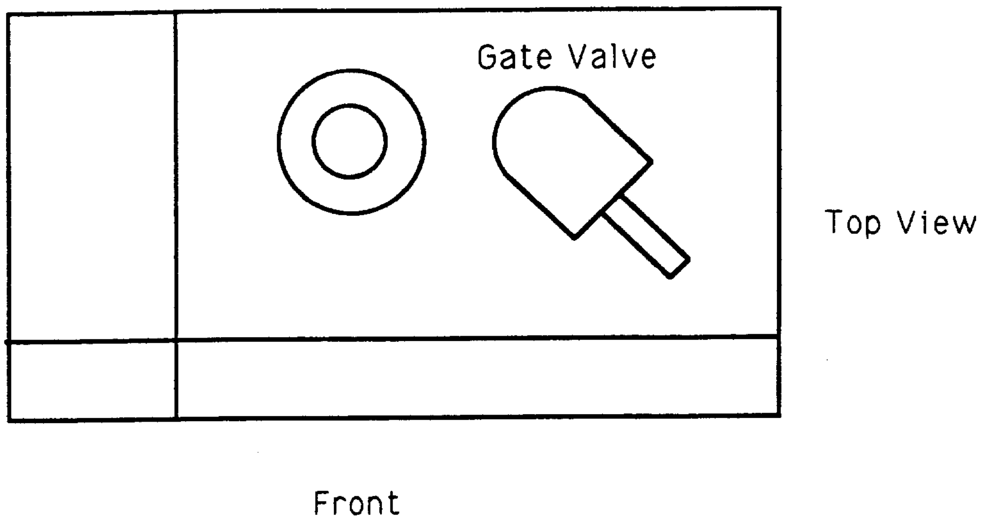
Valve Mounting Position




DuPont 120 SSA or 24/120